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Applying Knowledge Management to an Organization's Transformation

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International Space Station and Spacecraft Processing Directorate

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Topics

- Background
 - What NASA is Doing and Why
 - What Kennedy Space Center's International Space Station and Spacecraft Processing Directorate (ISSSPD) is Doing and Why it Matters
 - Transition and effects
- Introduction to the ISSSPD
 - Function
 - History
 - Goals
- Current Knowledge Management Infrastructure
- Self-propagating Knowledge Market
- Intentional Transformation



NASA's Exploration Mission Necessitates a Massive Transition

*"NASA is not going out of business, but rather beginning a new way of doing business for the next 50 years. We are **extending our reach beyond low earth orbit**, which is truly exciting."*- William Gerstenmaier, NASA's Associate Administrator for Space Operations.

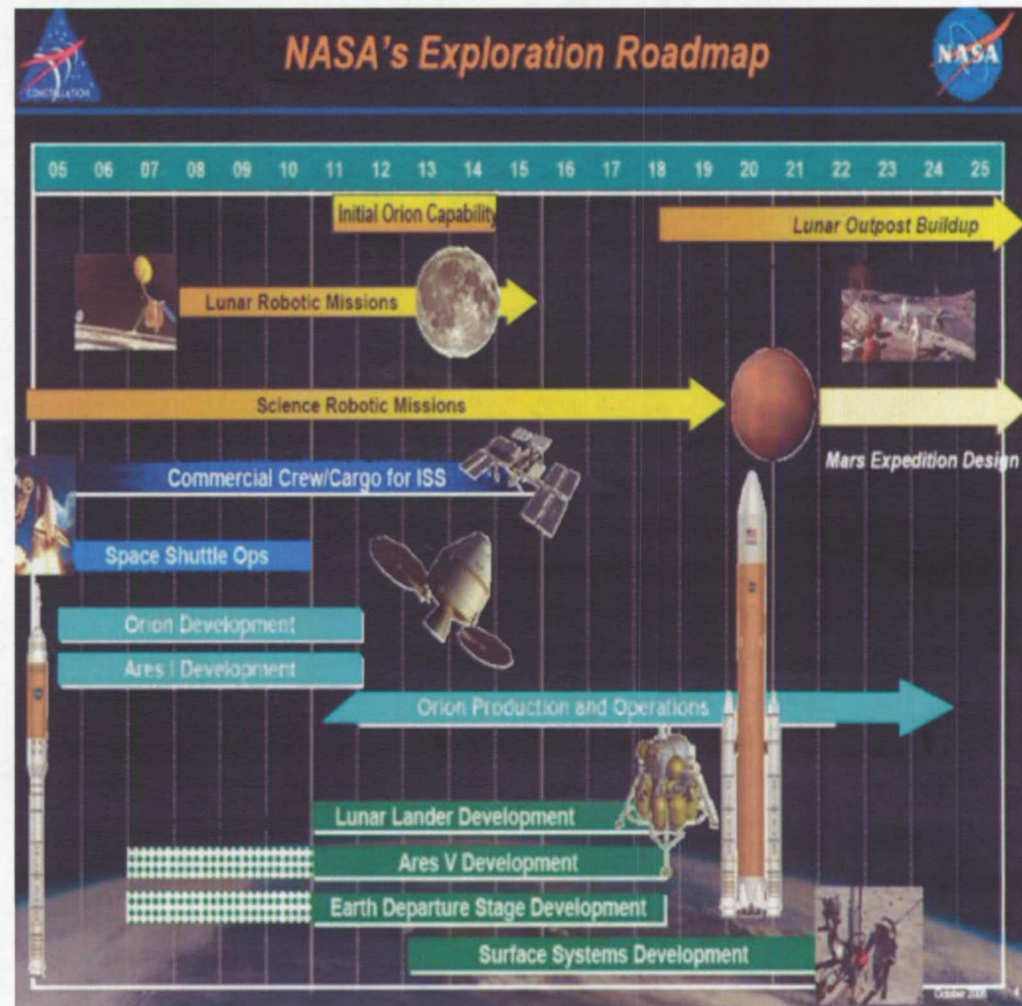
NASA's Space Shuttle Program occupies 640 facilities valued at approx. \$5.7 billion, and uses over 900,000 pieces of equipment valued over \$12 billion.

The **vast majority of personnel** from four NASA Centers **will assume new roles**:

- Johnson Space Center
- Kennedy Space Center
- Marshall Spaceflight Center
- Stennis Space Center.

NASA's future in human space flight depends on a safe, successful, and smooth transition to its **new Constellation Program (CxP).**

Knowledge is a critical asset to manage throughout the transition process.



Conceptual schedule from NASA's Exploration Systems Architecture Study team.



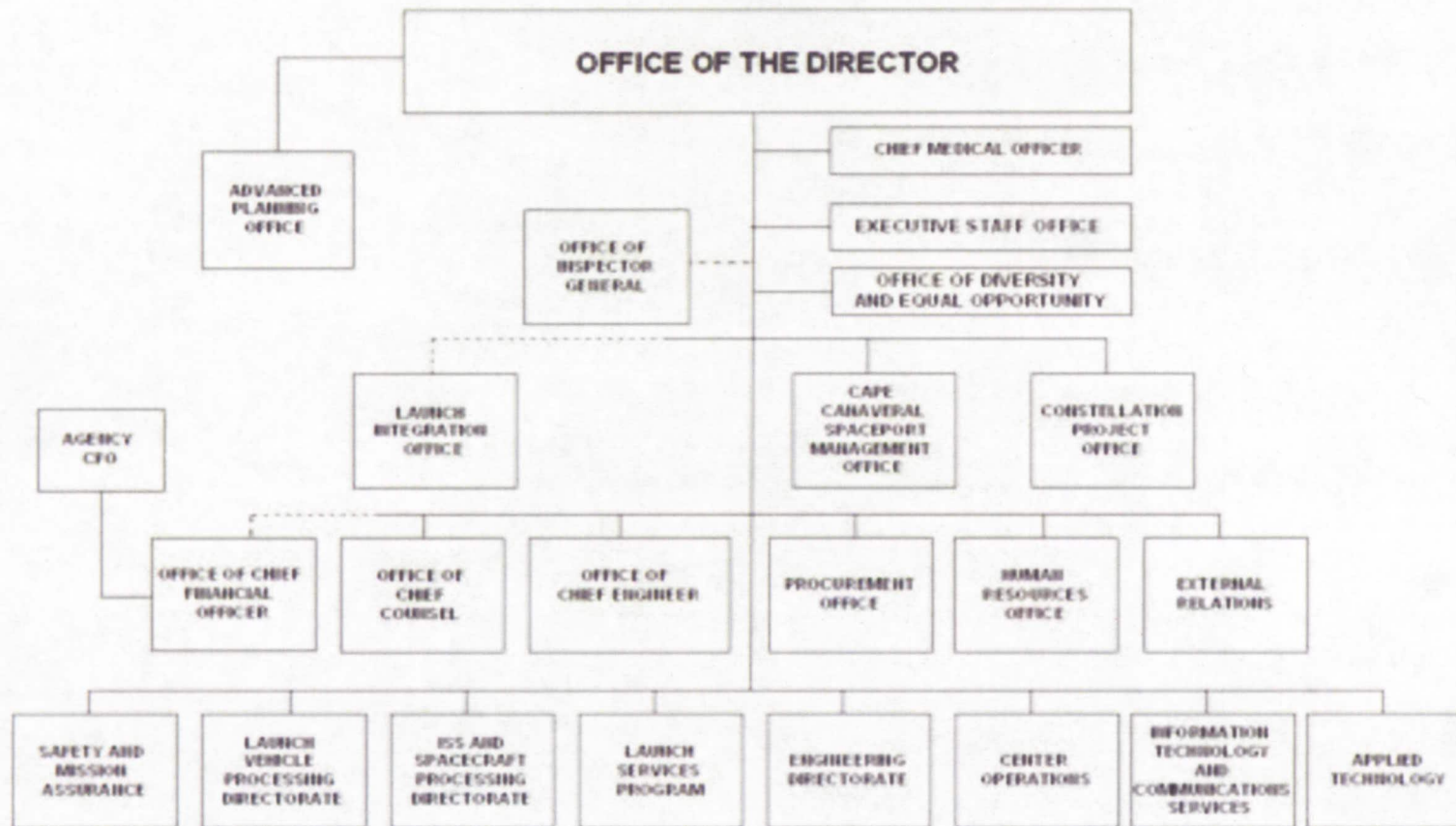
NASA's John F. Kennedy Space Center has helped set the stage for America's adventure in space for more than four decades. The spaceport has served as the departure gate for every American manned mission and hundreds of advanced scientific spacecraft. From the early days of Project Mercury to the space shuttle and International Space Station, from the Hubble Space Telescope to the Mars Exploration Rovers, the center enjoys a rich heritage in its vital role as NASA's processing and launch center. As the nation embarks on a new chapter in space exploration, Kennedy will continue to make history.

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(ref: <http://www.nasa.gov/centers/kennedy/about/history/index.html>)



JOHN F. KENNEDY SPACE CENTER (KSC)



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The International Space Station/Payload Processing directorate directs and manages the launch site support, ground processing, and integration of Space Shuttle payloads, payload carriers, and Space Station components including assembly elements, resupply cargo, and utilization experiments. The directorate manages the site facilities, ground support equipment, checkout systems, and ground transportation systems.(ref:

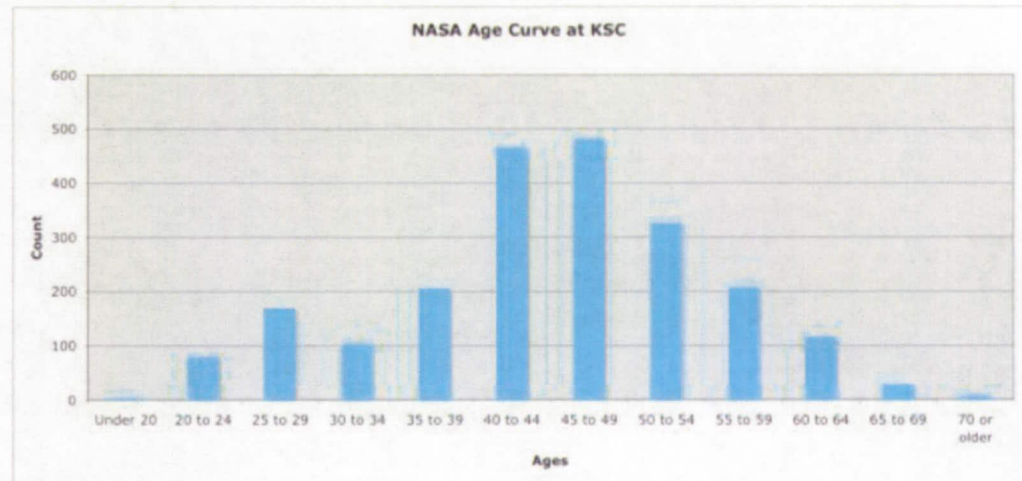
http://www.nasa.gov/centers/kennedy/about/information/ksc_org_chart.html) The directorate already includes a group of engineers dedicated to Constellation Operations for Orion and Altair.



KSC Workforce History and Projections

Average aged worker in Apollo days was 27!

Less than 2% of current NASA KSC employees in technical, science and engineering disciplines **worked on the Apollo Program.**



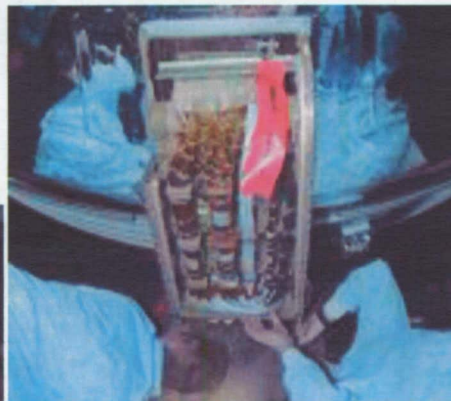
Estimated NASA KSC Civil Servant Knowledge Loss Risk

Year	Average Losses	Knowledge Lost (Months)	Knowledge Lost (Years)	Knowledge Per Person
2009	95.48	21555.48	1796.29	18.81325932
2010	95.54	22116.29	1843.024167	19.29060254
2011	92.79	22084.35	1840.3625	19.8336297
2012	89.93	22104.31	1842.025833	20.48288484
2013	89.63	22912.84	1909.403333	21.3031723
2014	88.45	23228.05	1935.670833	21.88435086
2015	86.74	23712.15	1976.0125	22.78086811
Total	638.56	157713.47	13142.78917	20.58191739

KSC could experience post-Shuttle **contractor workforce losses of 20-45%**, based on TBD future requirements.



Knowledge Harvesting from a Museum

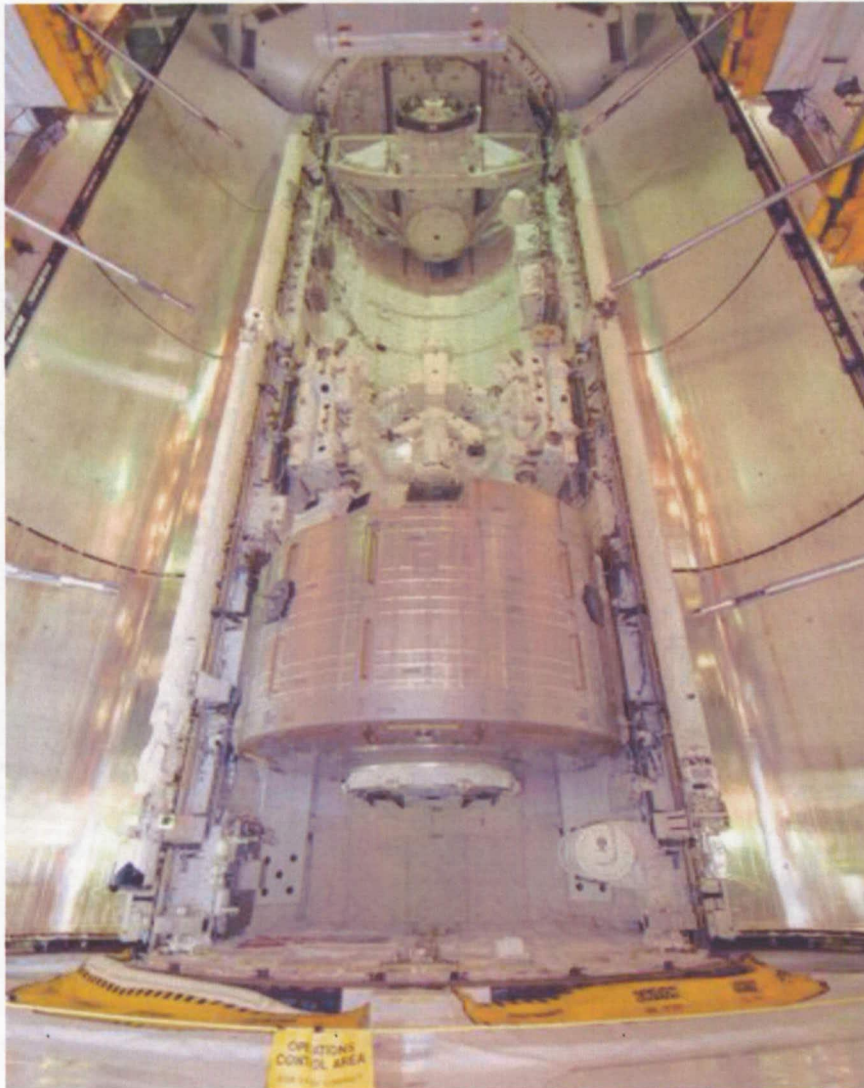


From: http://www.nasa.gov/mission_pages/constellation/orion/umbilical_inspection.html

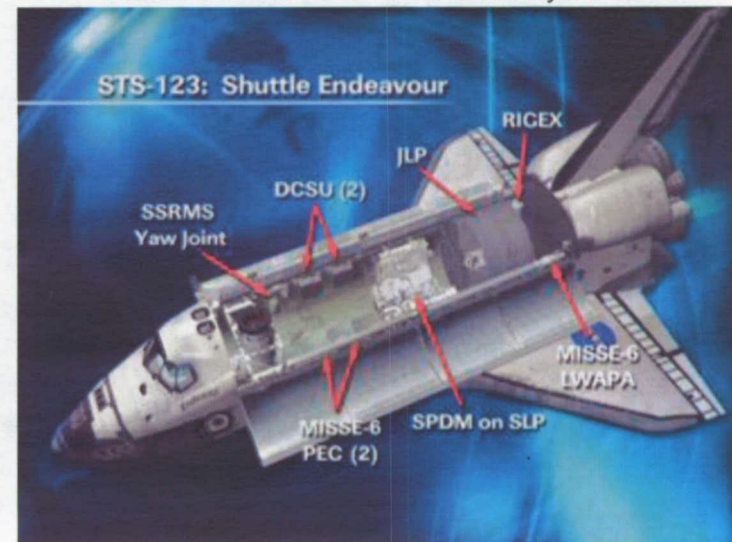


Mission 1JA/STS-123

Example of ISSSPD's Function, March 2008



- The 1JA/STS-123 mission complement installed in OV-105 (Space Shuttle Endeavour) at the launch pad
- At the top is a Spacelab Pallet with the Canadian "Dextre" mounted on it
- Below the Pallet is the Japanese Experiment Module - Pressurized Section (ELM-PS) containing 8 racks destined for the JAXA Pressurized Module.
- On the sidewall of the Orbiter are a spare Space Station Remote Manipulator System (SSRMS) "Yaw" joint, two spare Direct Current Switching Units (DCSU), the RIGEX payload, and the 6th Materials on the ISS Experiment (MISSE-6 payload, in 3 pieces).
 - RIGEX (Rigidizable Inflatable Get-Away-Special Experiment) is a self-contained, automated experiment intended to collect data on space inflated and rigidized structures in which inflatable tubes are heated and cooled to form structurally stiff tubes.





ISS Assembly Sites Assisted by KSC Employees

Part of ISSSPD's History



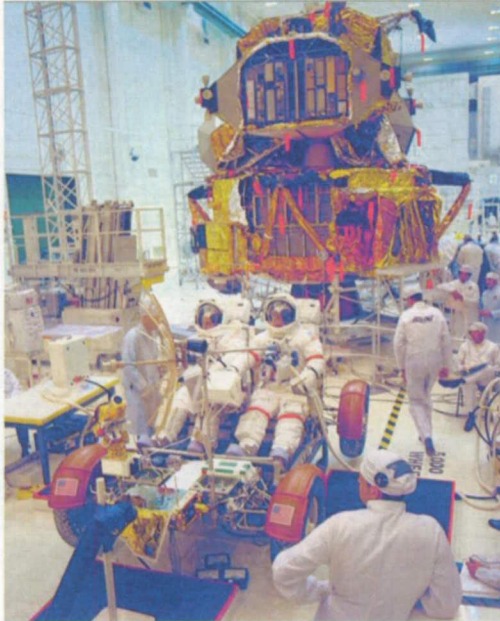
- Denver CO - Lockheed Martin, Element level Qualification Testing
- Huntsville AL - Boeing, Manufacturing and Assembly for US Lab and Trusses
- Huntington Beach CA - McDonnell Douglas/Boeing, Truss structures/electronics
- Canoga Park CA - Rocketdyne/Boeing, Truss structures/electronics
- Santa Barbara CA - McDonnell Douglas subcontractor, KU band Antennae
- Palo Alto CA - Space Systems Loral, Electronics
- Phoenix AZ - Honeywell, Communications equipment, software, firmware, MDMs
- Sunnyvale CA - Lockheed Martin, Solar arrays
- Windsor Locks CT, Hamilton Sundstrand (Rocketdyne sub); Fluid pumps

- Tulsa OK, Rocketdyne/Boeing; Final assembly for trusses
- Renton WA, Rocketdyne/Boeing; Qualification testing for trusses
- Downey CA, Rocketdyne/Boeing; Qualification testing for trusses
- Brampton ON Canada; SSRMS Final Assembly
- Torino Italy; MPLM Final Assembly, all MPLMs & Nodes
- Bremen Germany; ESA's Columbus Module Assembly
- Tsukuba, Ibaraki Japan; JAXA manufacturing and meeting site
- Salisbury MD, Harvard Manufacturing; Electronic assemblies
- Plum Brook OH; Qualification testing for radiators
- Dallas TX, Lockheed Martin; Radiators
- Kennedy Space Center FL; Flight Acceptance Testing, closeouts and launch



Representation of ISSSPD's Transformation Goal

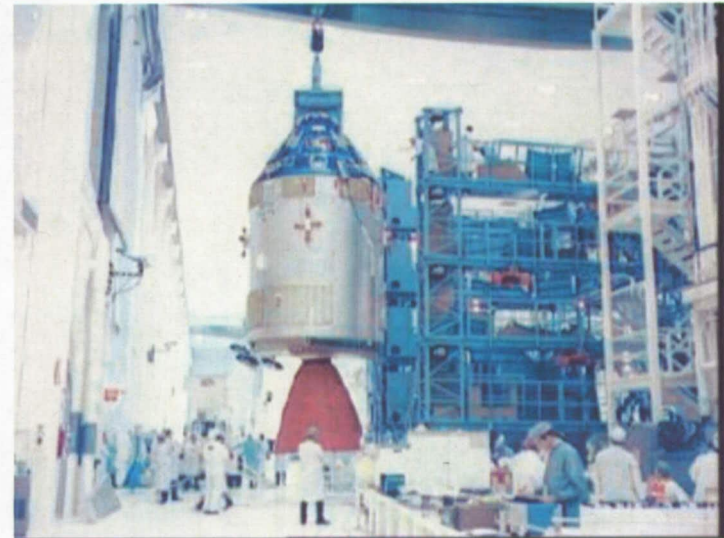
Leveraging Generations of Organizations' Valuable Experiences



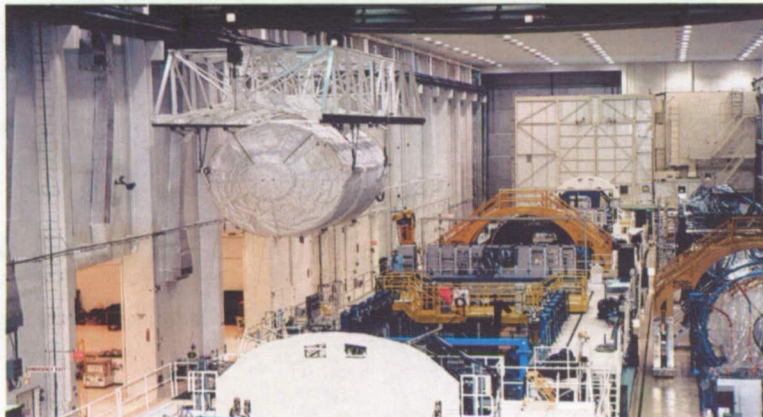
Apollo 17
Lunar
Module and
Rover under
test

Apollo 10
Command
and Service
Modules
being
prepared
for flight

**All images of work
performed in KSC
Operations and
Checkout Building**



STS-83 Materials Science Laboratory
Spacelab module leaving for orbiter integration



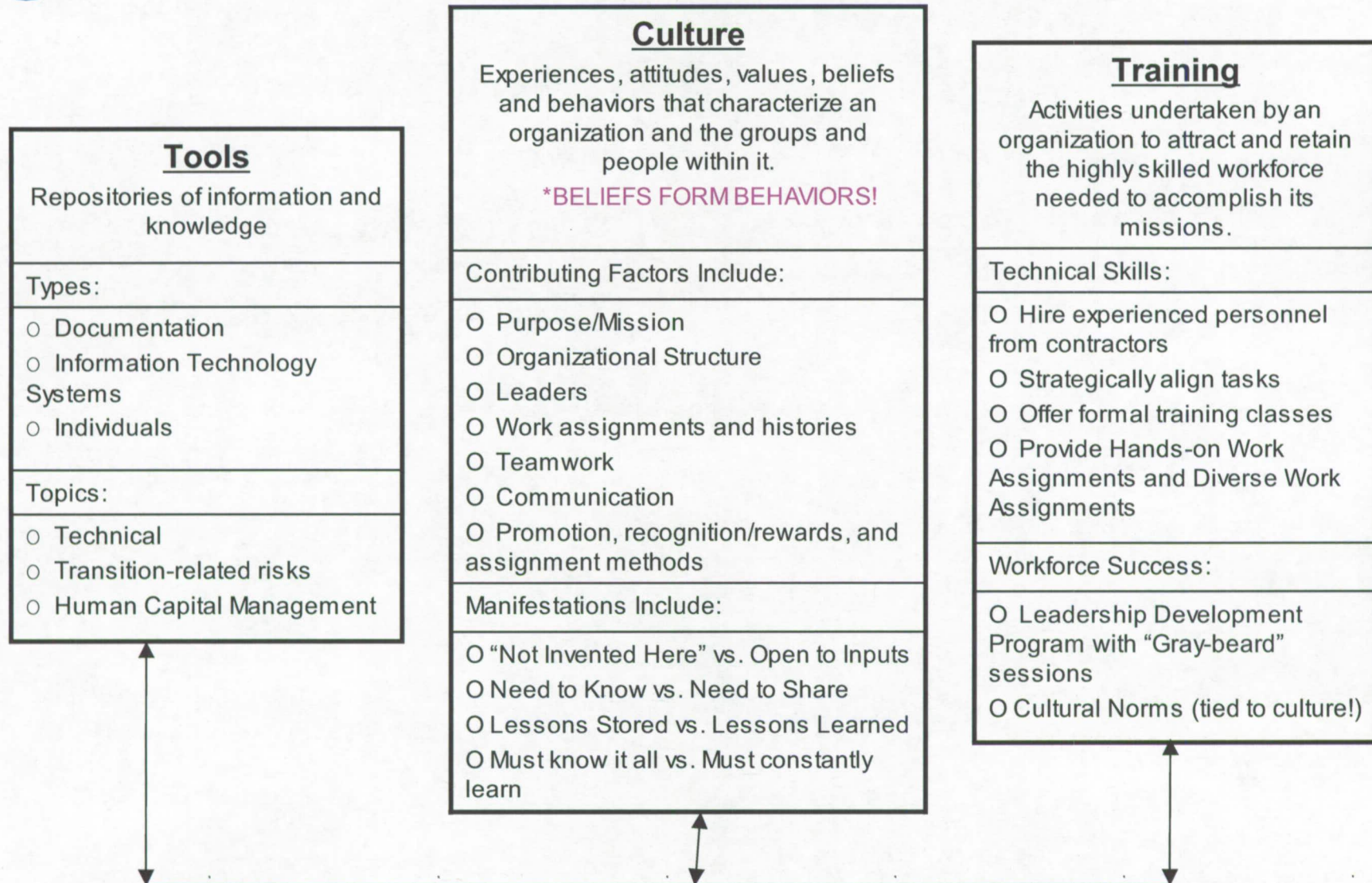
Planned Orion
work stands for
manufacturing
and assembly
of Command
and Service
Modules





Current ISSSPD KM Infrastructure

Available to Knowledge Workers in ISS (KW-I)

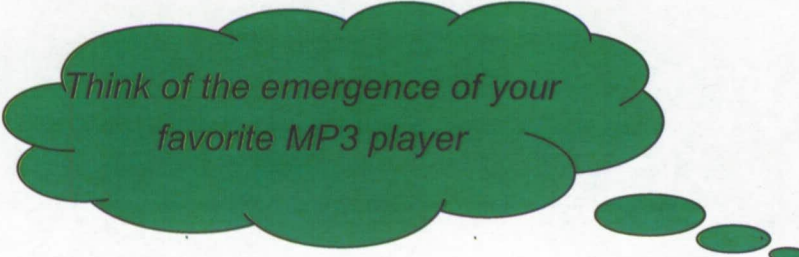




So What?

- What does it take to make this infrastructure usable and increase its value/ROI?
- How can it help us identify and transfer critical knowledge from KW-I to KW-C? (leverage experiences, lessons, and best practices)

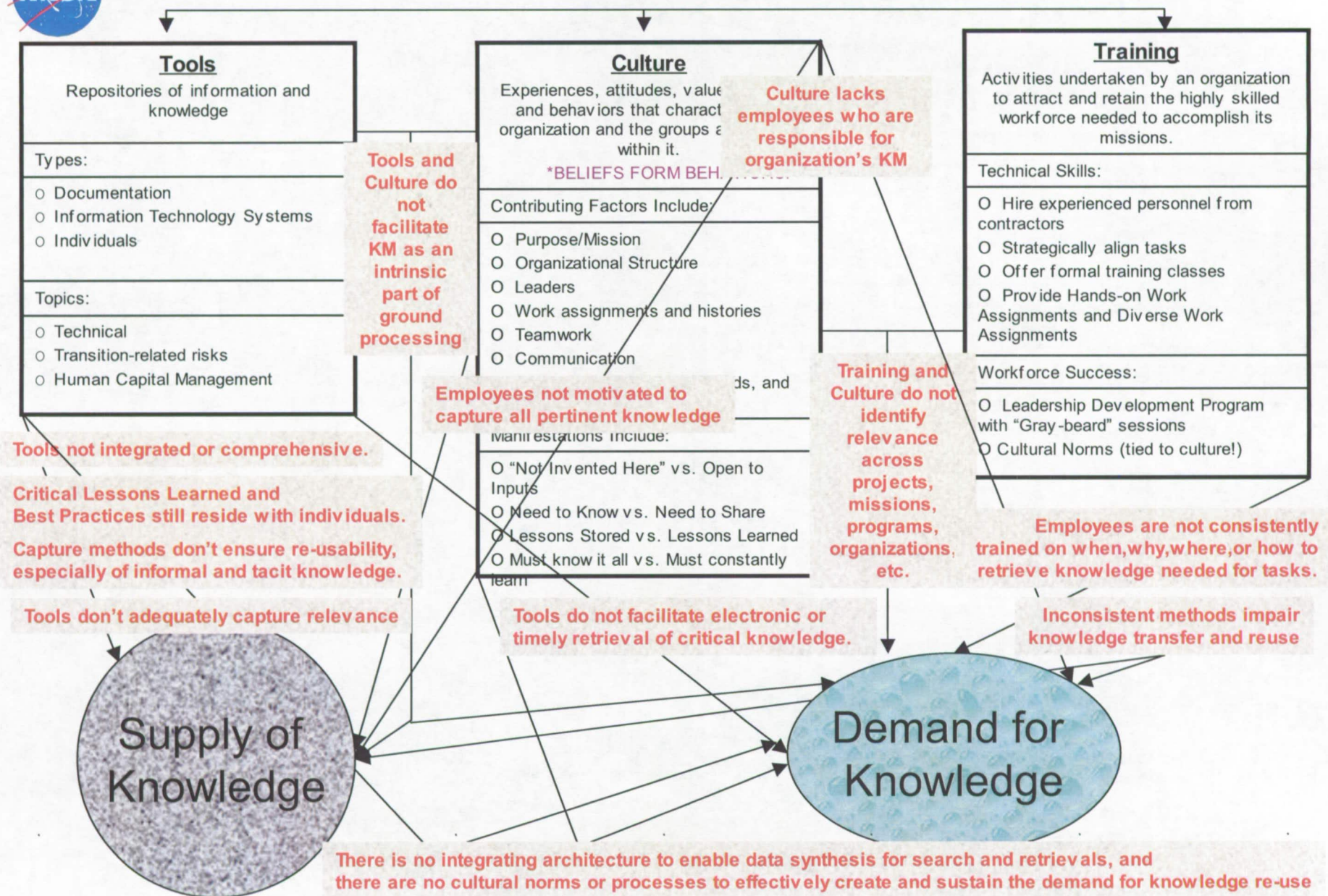
Understanding **today's weaknesses** & **tomorrow's circumstances** can help leverage the infrastructure, and **create a healthy market**



Think of the emergence of your favorite MP3 player



Current ISSSPD Knowledge Market and Weaknesses





Factors Influencing Market Conditions

ISSSPD's Evolutionary Transition

ISS via STS (shuttle)

Other payloads for STS

ISS via Commercial Vehicles: Planning, Development, Operations

CxP Planning and Development (Flight & Ground Support systems for Orion & Altair)

Orion Production and Operations

Altair Planning and Development

Surface Systems and Lunar Outpost Planning and Development

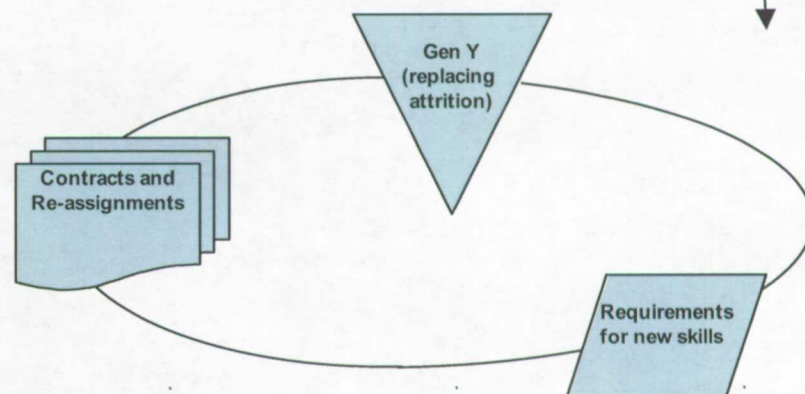
CxP's Evolutionary Design

New customers, tools, missions, technology, processes, personnel, risks

As the program progresses, changes to resources and requirements occur

All of these factors effect the tools (docs, IT, people) in the ISSSPD KM infrastructure

Workforce Evolutions





Target ISSSPD KM Infrastructure

Needed by Knowledge Workers in CxP (KW-C)

<u>Tools</u>
Repositories of information and knowledge (+ new sources)
Types:
○ Documentation ○ Information Technology Systems - enablers of robust KM ○ Individuals
Topics:
○ Technical ○ Transition-related risks ○ Human Capital Management ○ KW-I relevant & tacit knowledge ○ Team building/teamwork ○ Contract Management ○ Acquisition Strategies ○ ISS and STS Retirement ○ Customer Service ○ TBD (e.g. knowledge gained as we progress)

<u>Culture</u>
Experiences, attitudes, values, beliefs and behaviors that characterize an organization and the groups and people within it. *BELIEFS FORM BEHAVIORS!
Contributing Factors Include:
○ Purpose/Mission ○ Organizational Structure- includes strategically-placed, empowered Knowledge Workers ("missionaries, farmers, bridge builders") ○ Leaders - embrace and model KM ○ Work assignments and histories ○ Teamwork ○ Communication ○ Promotion, recognition/rewards, and assignment methods ○ Intrinsic Motivation to learn and teach
Manifestations Include:
○ "Not Invented Here" vs. Open to Inputs ○ Need to Know vs. Need to Share ○ Lessons Stored vs. Lessons Learned ○ Must know it all vs. Must constantly learn

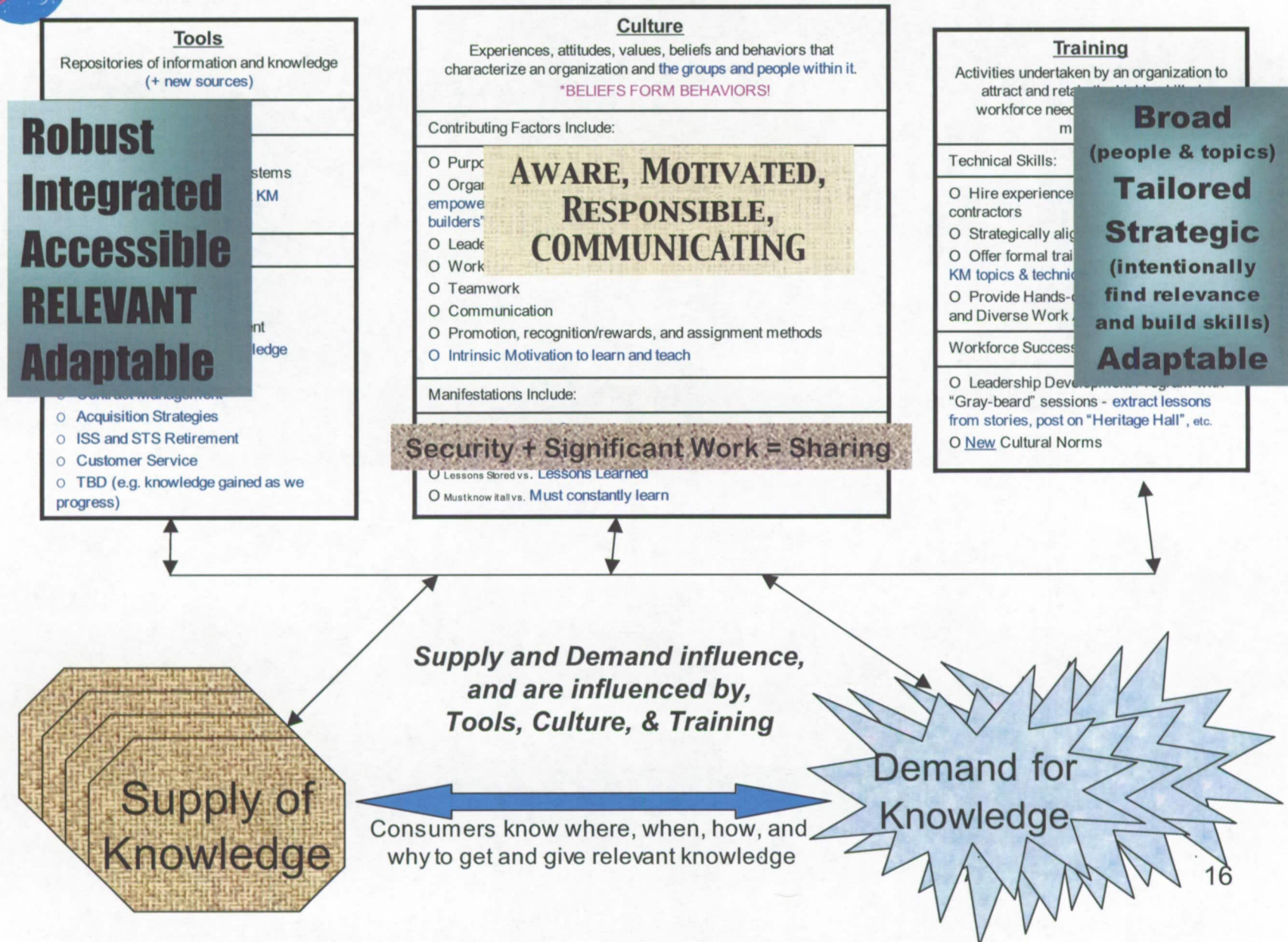
<u>Training</u>
Activities undertaken by an organization to attract and retain the highly skilled workforce needed to accomplish its missions.
Technical Skills:
○ Hire experienced personnel from contractors ○ Strategically align tasks ○ Offer formal training classes - include KM topics & techniques ○ Provide Hands-on Work Assignments and Diverse Work Assignments
Workforce Success:
○ Leadership Development Program with "Gray-beard" sessions - extract lessons from stories, post on "Heritage Hall", etc. ○ New Cultural Norms





A Self-Propagating Knowledge Market for ISSSPD

Enables Continuous Knowledge Cultivation, Transfer, and Incorporation





Now What?

- “Necessity is the mother of invention” - the impending transition is a forcing function for the required transformation
 - NASA’s future in human space flight depends on its safe, successful, and smooth transition
 - Knowledge is a critical asset to manage throughout the transition process
- Initial Steps Forward
 - Build and integrate the required KM team (inside and out)
 - Beg, Borrow, and Steal
- Establishing good KM in an organization is an 8-9 year effort
 - Patience is a virtue
 - Persistence pays off
- ISSSPD is a microcosm - its efforts have widespread payoff

The heart of KM is...
Leveraging Organizations’ Valuable Experiences 



<http://www.nasaimages.org/luna/servlet/detail/nasaNAS~20~20~120199~226898:Auroras-Underfoot>